LETTERS TO THE EDITOR

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[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Divisibility of the Electric Light

THE English and American periodicals devoted to electrical science now announce, "on authority," that the electric light discovered by Edison is a light by incandescence. If this be true there is nothing new or startling either in the discovery of the light or of its divisibility. Lighting by incandescence has been studied for a long time; indeed, it has been studied much more thoroughly than any other kind of electric lighting. Thirty-three years ago a method of producing and sub-dividing the light was patented in England by a Mr. King. The light was produced by heating to white heat in a vacuum, by means of the electric current, either platinum or carbons; and, the specification adds, "when the current is of sufficient intensity, two or a larger number of lights may be placed in the same circuit." For some years after this discovery several improvements on King's invention were patented in America, France, and England; "but," says M. Fontaine, "none of these appear more complete, more explicit, and more practicable than King's; it is, then, useless to continue our nomenclature." The principle of lighting by incandescence, although not neglected or forgotten, seems to have made but little progress until 1871, when M. Lodyguine showed an experiment in the Admiralty Dockyard in St. Petersburg, when he divided the circuit into no less than two hundred lights. This naturally made a great sensation at the time—as great a sensation as that caused by Mr. Edison's telegram of the 7th ult. The Academy of Science awarded to M. Lodyguine the large Lomonossow prize of 50,000 roubles. A company was formed in St. Petersburg with a capital of 200,000 roubles, and the excitement in Europe was then almost as great as has been witnessed in England lately. It was soon found, however, that Lodyguine's discoveries, like those of his predecessors in the same field were, after all, impracticable, and that his illimitable division of the light, however ingenious, was only a fanciful experiment. Every penny subscribed to the company referred to was lost, and Lodyguine's great discovery is now, where it was then—in his laboratory.

It has, however, been urged that these early inventors of the electric light knew only of the galvanic battery as a generator of a powerful current, and that had they known of the Gramme machine, or other dynamo- or magneto-electric machine, the results might have been different. The remark, however, only applies to King and the improvers who immediately succeeded him. The great division of the light by Lodyguine, to which reference has just been made, was in a circuit produced by two "Alliance" machines. Even, however, if such were not the case, there are at present before the world, in more or less detail, four recent inventions for the production of a divided light by incandescence. These are the inventions of M. Reynier, of M. Arnaud, of Mr. Edison, and most recent of all, M. Werdermann. From the way in which these discoveries—if they are discoveries—have been ushered into the world, it is found that great claims are made on their behalf, and there are, therefore, naturally great expectations on the part of the public in regard to them. It cannot be urged now in mitigation of the shortcomings of the incandescent light, as it has been urged in the past, that it has not had a fair trial, on the ground that the lamps in existence were imperfect in conception, and complex in construction. The lamp of M. Reynier seems admirable in its way, and if light by incandescence were to be the light of the future, the claims of this lamp would have to be very carefully considered, and, in any case, it will certainly hold an important place in all investigations into the subject. The lamp of M. Werdermann appears to be identical in principle with, and only slightly different in detail from, that of M. Reynier, and we may fully expect that these inventors will have to come to terms with each other—so much alike are their inventions. Of the details of Mr. Edison's invention—if there are any, nothing is known beyond the fact stated in the *Scientific American*, that it is a light produced from a spiral of incandescent platinum; while the reports in the American daily press show such an effervescent ignorance of the fundamental principles both of electricity and of dynamics, that no reliance whatever can be placed upon them.

Experience, then, has shown that a light by incandescence comes before us in a very questionable shape, and it is essentially a light which discourages the notion of its practical application. The question indeed may be very properly asked: How is it that light by incandescence has always proved such an utter failure? It has had a period of thirty-three years in which to develop; it has been divided into various lesser lights, numbering from two to two hundred: and it has arrested the attention and taxed the skill of the greatest electricians in the world. How is it that it is obliged to give way to light by the voltaic arc? The answer is at hand. The light by incandescence can only be obtained and divided by a great sacrifice of light and power. This is imperative from the fundamental principles of electrical science. The diminution according to the "square," and not according to simple proportion, applies to electricity just as it applies to light, heat, sound, gravitation, and other physical phenomena. Thus if a circuit be divided into two branches whose resistances are equal, a current of half the strength passes through each branch, producing at the point of resistance, not half the light, but only a quarter, because the effect follows the square of the current strength. If the current had been divided into three equal branches, in each branch only one-ninth part of the original light would be obtained, and so on; so that if an electric light of 1,000 candles were divided into ten equal lights, the result would be ten lights of ten candles each, instead of one of 1,000 candles. When this law is borne in mind, and when it is also remembered that to produce the electric light by incandescence at least one-half of the current is lost, it will easily be imagined what a wasteful light it is. Recent experiments prove this. It was recently stated, in reference to M. Werdermann's incandescent light, that he produced two lights of 320 candles each (total, 640 candles), with a prime mover of 2 horse-power; and this was considered a great result—as indeed it was for an incandescent light. But how this sinks into insignificance when compared with the results of lighting by the voltaic arc. A few days ago M. Rapieff, with two of his regulators and a small Gramme machine known as the M machine, and which M. Gramme says requires only 1½ horse-power, produced two lights, which, when carefully measured by the photometer, were found to be each equal to 1,150 candles, or a total of 2,300 candles, while with one of M. Gramme's A machines, requiring 2½ horse-power, a light of 6,000 candles can be obtained from one of M. Rapieff's regulators. Some experiments detailed in M. Fontaine's book on "Electric Lighting" gave a similar result. M. Fontaine's experiments with an incandescent light show that, under the most favourable circumstances, with a Bunsen battery of forty-eight cells, eight inches high, the diminution of the sub-divided light was so great that, where he put five lights in one circuit, he only obtained a total illuminating power of a quarter of a burner, with four lamps only three-quarters of a burner, with two lamps six-and-a-half burners, and with one lamp fifty-four burners. These numbers give the following ratio: 1, 3, 8, 26, 216, thus showing how rapidly the light diminishes when divided. With the voltaic arc, however, and with the same battery, he was able, by a Serrin lamp, to obtain a light of 105 burners.

It will be seen, then, from what has been above stated, that the production and the divisibility of the light by incandescence is a very wasteful process—so wasteful, indeed, as to render its practical application impossible for general lighting. If, therefore, all Mr. Edison has to announce to the world is that he has succeeded in dividing an incandescent light—and the announcement that such is so is made on authority—his discovery amounts to very little. Both the light and its divisibility were discovered long ago. It will easily be seen that it is not in that direction that any great practical results can be obtained. The voltaic arc supplies the only divisible light of any utility and economy, and it is in its development that any real progress must be looked for.

WILLIAM TRANT

Duplexing the Atlantic Cable

I HAVE read with surprise in your number of the 14th inst. (vol. xix. p. 38), an article, in which it is implied that the application of the duplex method of signalling to an Atlantic cable has now for the first time been successfully accomplished by Mr. Stearns.

The publication in the *Times* of Sir James Anderson's letter on "the duplex system in telegraphing," on the day after the publication of your article, was a coincidence of which I trust

you will in fairness allow me to take advantage, to prove that your article does scant justice to Mr. Stearns' predecessors in the application of the duplex system to long submarine cables, and that their success has been something more than "only partial" in the opinion of those who have employed their system.

Mr. Stearns' first success on a long cable dates from a few days ago. In February, 1876, Dr. Muirhead and myself obtained experimentally a perfect balance on the Suez-Aden cable, which, though shorter in miles, is electrically longer than either of the Anglo Company's cables from Valentia on which Mr. Stearns has worked.

In March of the same year Mr. J. Muirhead and myself duplexed the Marseilles-Malta cable, which, though only 825 miles in length, is worked by Sir W. Thomson's syphon recorder, and our system has been in commercial operation on the line ever since.

Early in 1877 Dr. Muirhead applied the system to the Aden-Bombay Cable, which is longer in miles and far longer electrically than either of the cables from Valentia, and since that time this line, as well as that from Suez to Aden, has been worked "duplex" whenever the traffic required it, to the entire satisfaction of the company.

Next, as to your remark that "Mr. Muirhead has been at work duplexing the Direct United States Cable with some prospect of success," the facts of the case are these :—

The cable, in its linear measurement, exceeds the longest Valentia cable by 543 miles ; electrically it is twice as long.

It is worked with the mirror galvanometer, and not with the recorder, and these circumstances render the difficulty of obtaining a duplex balance upon it immensely greater than upon any of the other lines referred to.

Notwithstanding the difficulties mentioned, Dr. Muirhead and myself, in April last, obtained a perfectly satisfactory balance, enabling us to transmit sixteen words a minute in both directions at the same time, between Ireland and Nova Scotia, a cable distance of 2,420 nautical miles. HERBERT TAYLOR

7, Pope's Head Alley, Lombard Street

P.S.—Since writing the above my attention has been called to NATURE, vol. xv. p. 180, containing an article on this subject, in which the applications of Muirhead's system to some of the cables referred to in my letter are spoken of as being the first practical successes in submarine duplex telegraphy.

Remarkable Colour-Variation in Lizards

MR. WALLACE'S observations in NATURE, vol. xix. p. 4, on a black variety of the common lizard of Capri, as met with on the neighbouring islet of Faraglioni, induces me to refer to a similar appearance in the lizards frequenting the islet of Filfla, on the southern coast of Malta. As recorded in my book, "Notes of a Naturalist in the Nile Valley and Malta," p. 80, I have stated that during a visit to Filfla I was surprised to find that all the lizards on the rock were a beautiful bronze black and so much tamer than their timider brethren on the mainland. Many individuals were so tame that they scrambled about our feet and fed on the refuse of our luncheon. I subsequently sent specimens of this variety, or rather race, to Dr. Günther, F.R.S., who pronounced them identical with the *Podarcis muralis*, so extremely plentiful in Malta and Gozo. Now although the denizens of the two latter islands present divers shades of colouring, I never observed (and I looked carefully during several years) a black or dark-coloured individual. Filfla is about 600 yards in circumference and three miles distant from Malta. It is formed of the upper miocene limestone, and marks an important fault or down-throw which runs along the coast of Malta opposite, by which, as seen in the sketches Figs. 1 and 2 of the work referred to, it appears clear that the severance took place long subsequent to the days of the pigmy elephants, hippos, giant dormice and tortoises, whose remains have been found in such abundance in the crevices of the rocks opposite Filfla. There is no verdure on this bare rock-islet, the surface of which is dark-coloured, whilst its crevices shelter the lizards and furnish abodes for the nests of Manx and cenereous shearwaters, whose docility at the breeding season is equally remarkable, both reptile and birds being like their compeers of Enoch Arden's island, "so wild that they were tame."

Probably the dark colouring is protective, and thus consorting well with the surrounding surfaces, would tend to preserve them from the harriers, buzzards, and hawks which tarry in the Maltese Islands during the spring and autumn migrations

November 11 A. LEITH ADAMS

THE remarkable case of local colour-variation in lizards communicated by Mr. A. R. Wallace to NATURE (vol. xix. p. 4), had already been investigated by Dr. Theodor Eimer, an abstract or translation of whose memoir on the subject, entitled "*Lacertæ muralis cærulea*, a Contribution to the Darwinian Theory," is to be found in *Ann. and Mag. Nat. Hist.*, 1875, 4th ser., vol. xvi. p. 234. J. WOOD-MASON

54, Claverton Street, S.W., November 16

The Drought

AT the present time, when more attention is paid to the influence of meteorological phenomena upon society, it would be useful to give some information as to the bearing of the local droughts and famines on our trade and the prospect of its revival. The China and Indian trades have not yet recovered. The droughts have also affected Egypt and Morocco. In the West Indies, Guiana, Venezuela, Colombia, and Brazil they are still operative.

They act to prevent the growth of produce, and in many countries, by reducing the water-ways, they impede its shipment. The people cannot consume our imports, the transit of which is in some cases impeded. The whole of these difficulties affects the exchanges and interferes with the money market and remittances.

The severity of the crisis is abating, but we can hardly feel assured of the revival of trade in Europe and the United States till there is a complete recovery over the vast areas of producing and consuming countries.

Thus the study of meteorological phenomena and facts acquires a new value for practical men and society at large, as stated by Prof. Jevons in your last number. HYDE CLARKE

Sewerage and Drainage

IN NATURE, vol. xix. p. 1, you touch upon a most important point in sanitary engineering which I have for ten years been striving by every means in my power to press upon the public, and I therefore venture to trouble you with a few lines on the subject.

The most important argument in favour of the exclusion of storm water from sewers consists, as you say, in the liability of road detritus to form deposits on the wide flat surface of any channels large enough to convey to one point an exceptionally heavy fall of rain over the area covered by a town, and the inevitably slow course of the infinitely smaller volume of sewage flowing or stagnating in dry weather along the same channels.

When separate sewers are provided for sewage they can be made of such smaller capacity as to keep up a constant flow from the houses in which the sewage is produced, to the land upon which it is to be purified, because the volume of liquid will very nearly correspond with the water supply, and the engineer has safe data upon which to adjust his means to the desired end.

In every town there are, or were, lines of natural watercourses, and if the scavengers' work is properly done the rain-water from roofs and streets may safely be discharged into any of these by short lengths of drains, less liable to be encumbered with deposits of road detritus, and with the certainty that if such accumulations should occur, they will be perfectly harmless from the absence of sewage.

The experiments of Mr. Way with London street water have been seized upon by Mr. Baldwin Latham in order to cover his retreat from the false position unfortunately taken up by himself and most of our senior engineers in the earlier days of sanitary science, and as he knows as well as any one else that it was a grand mistake to confuse and combine *sewerage* and *drainage* in one system, I agree with you in thinking it a pity that he has not acknowledged the facts more distinctly in the recent edition of his well-known work.

The greater proportion of the impurities detected by Prof. Way in the few samples of London street water which he tested are mineral ones which would be comparatively harmless, and, in the opinion of Dr. Voelcker, the experiments must have been vitiated by some mistake. Now as the latter authority has